Rate and Anchorage Loss Following Decortication-Facilitated Orthodontics for Mandibular Molar Protraction: A Clinical Study

Supang Samansukumal¹*, Bancha Samsuajbenjakun¹, Chairat Charoemratrote, Narit Leepong²

¹Department of Preventive Dentistry, Faculty of Dentistry
²Department of Surgery Dentistry, Faculty of Dentistry
Prince of Songkla University, Songkhla, 90112 Thailand
*E-mail: s__supang@hotmail.com

Abstract

Orthodontic tooth movement through atrophic ridge is difficult and prolonged treatment time; especially when closing space on posterior teeth which space closed mainly by mesial movement of molars, because the rate of cortical bone remodeling is about 0.5 millimeter per month and lots of anchorage must be involved. **Objectives:** To evaluate the rate of mandibular molar protraction and the amount of anchorage loss following decortications-facilitated mandibular molar protraction. **Methods:** The experimental group consisted of 8 adult patients (3 males, 5 females). The patients had loss the right or the left mandibular first molar and the third molar was exist. After leveled and aligned until obtain normal alignment, the patients refered to the oral surgery clinic for alveolar decortication and bone graft at edentulous area. Two weeks later, segmented L-loop used to protract molar and activated every 2 weeks until space was closed. The lateral cephalometric radiographs were taken 2 times; before alveolar decortications (T1) and after space closed (T2). The rate of mandibular molar protraction and the amount of anchorage loss following decortications-facilitated mandibular molar protraction were analyzed for difference between before alveolar decortications and after space closed (T2-T1). Mann-Whitney U test was used for statistical analysis. **Results:** The rate of mandibular molar protraction in the experimental group was 1.22 ± 0.17 millimeter per month that statistically significant (p<0.01) greater than the control group; 0.36 ± 0.18 millimeter per month. The amount of anchorage loss following decortications-facilitated mandibular molar protraction in the experimental group was 0.62 ± 0.44 millimeter per month that statistically significant (p<0.05) lesser than the control group; 1.36 ± 1.07 millimeter per month. **Conclusions:** Decortication-facilitated orthodontics treatment could protract the mandibular molar more rapidly and less anchorage loss than the conventional orthodontic treatment.

**Keywords:** Periodontally Accelerated Osteogenic Orthodontics (PAOO), Mandibular Molar Protraction, Accelerated Rate of Orthodontic Tooth Movement, Diminished Anchorage Loss

Introduction

After extraction of teeth, the alveolar portion of the jaws starts to atrophy[1, 2] because the extraction per se, clot retraction, resorption of alveolar bone during the healing process or mastication impairment. Displacement of teeth into substantial atrophy of the alveolar ridge has considered a major limitation; especially in the posterior part of the mandibular arch, because of predominately cortical bone, less trabecular bone, less cellular, less vascular and the mandibular molar roots are extremely wide buccolingually [3-6]. Robert et al [7] stated that orthodontic translation through cortical bone was limited by the linear rate of osteoclastic resorption, which is about 0.5 millimeter per month. Therefore, mesial movement of the mandibular molar to close the atrophic extraction site is prolong
treatment time, seldom possible and demand substantial anchorage [7-9]. Previous studies, many methods have used to obtain sufficient anchorage for protraction of mandibular molars including osteointegrated implants [7, 12, 14], mini-plates or miniscrews[11, 13]; the mechanic of protraction was done with closing loops, c-chain or NiTi close coil spring however these mechanics could not reduce the treatment time. Recently method called “Periodontally Accelerated Osteogenic Orthodontics (PAOO)” or “Wilckodontics” [15]; full-thickness flap, decortications and bone augmentation, can reduce treatment time [16, 17] and resistance for orthodontic tooth movement. Up to now, there are no studies that evaluate the effectiveness of using decortication-facilitated orthodontics for mandibular molar protraction. The purposes of this study were to evaluate the rate of mandibular molar protraction and the amount of anchorage loss following decortications-facilitated mandibular molar protraction

Materials and Methods
Sample selection
The experimental group comprised of 8 adult patients (3 males, 5 females) from the Orthodontic clinic, Dental hospital, Faculty of Dentistry, Prince of Songkla University who had met the following criterias; (1) age 18-35 years old, (2) lost of mandibular first molar, (3) the treatment plan was moderate anchorage, (4) after mandibular molars protraction, the lastest tooth in opposite arch had occluded, (5) the patients could return to follow up and activation of appliance every 2 weeks until space closed, (6) the patients had good general health, no long term use of corticosteroid, NSIADs and bisphostphanate [18], (7) no signs and symptoms of periodontal disease. Each patient was informed about the experimental procedure and the consent form was signed for participating in this study. This study was certified by ethic committee of Faculty of Dentistry, Prince of Songkla University. The patients was divided in two groups; the control group consisted of 7 previous experimental studies which received the conventional orthodontic treatment, closing extraction site by closing loop rectangular wire. The experimental group consisted of 8 adult patients, treated with closing loop rectangular wire and decortication-facilitated orthodontics for mandibular molar protraction.

Surgical procedure
After the teeth were leveled and aligned, the surgical procedures were performed with the patients under local anesthesia. Full-thickness flaps were raised on both buccal and lingual surfaces to expose the alveolus surrounding edentulous area and extend posteriorly to the second molar. Selective alveolar decortications were made in the cortical plate with the proper size of round carbide burs in difference areas, barely penetrating the trabecular bone (Fig.1).

Fig. 1 Selective alveolar decortications
Bone grafting with allograft and autogenous bone (from decortications procedure) was added to the corticotomy site (Fig. 2). Finally, the flaps were repositioned and sutured appropriately.

Fig 2. Bone grafting added to the corticotomy site
Clinical procedure
Initial records (T0) composed of lateral cephalometric, panoramic and periapical
radiographs, extra-oral and intra-oral photographs, upper and lower impressions for study models. Pre-adjusted edgewise appliances (Roth prescription) with 0.018”-slot in anterior teeth and 0.022”-slot in posterior teeth were used for all teeth. The teeth were leveled and aligned until obtain normal alignment. Then, pre-operation records (T1) were taken including lateral cephalometric radiographs, intra-oral photographs, upper and lower impressions for study models. After that the patient was refered to the oral surgery clinic for alveolar decortications and bone graft with the same surgeon. Two weeks later, segmented L-loop was used to protract molar and activated every 2 weeks until space closed (Fig 3). The impressions and intra-oral photographs were taken every month. After space closed, lateral cephalometric radiograph was taken (T2).

The distance of the mandibular second molar movement was measured from the most anterior contour of the mandibular second molar parallel to OP, to OPP. The distance of the mandibular second premolar was measured from the most posterior contour of the mandibular second premolar parallel to OP, to OP (Fig. 4).

**Fig. 3** Segmented L-loop was used for protraction of mandibular molar

**Data measurements**

The lateral cephalometric radiographs were taken 2 times; before alveolar decortications (T1) and after space closed (T2). The rate of mandibular molar protraction and the amount of anchorage loss were analyzed by difference between before alveolar decortications and after space closed (T2-T1). The occlusal plane (OP) and the occlusal plane perpendicular (OPP) from the first lateral cephalometric radiograph were used as a reference grid. The grid was transferred from the first tracing to the following tracings by superimposition of the tracing on the nasion-sella plane (NSP) with sella (S) as registering point [19].

**Fig. 4** Measurement of the mandibular second molar and mandibular second premolar position

**Statistic analysis**

Linear measurements were made to the nearest 0.5 millimeter. The reproducibility of the measurements was evaluated by statistically analyzing the difference between double measurements. The error of the method calculated with Dahlberg’s formula (intra-observer reliability). Mann-Whitney U test was used to compare the rate of molar protraction and amount of anchorage loss between experimental group and control groups. The values of $P < .01$ for rate of molar protraction and $P < .05$ for amount of
anchorage loss were evaluated as statistically significant.

**Results and Discussion**

The descriptive data were shown in table 1 and 2. For experimental group, rate of mandibular molar protraction was $1.22 \pm 0.17$ and anchorage loss was $0.62 \pm 0.44$. For control group, rate of molar protraction was $0.36 \pm 0.18$ and anchorage loss was $1.36 \pm 1.07$.

<table>
<thead>
<tr>
<th>Rate of molar protraction</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>8</td>
<td>1.22</td>
<td>0.17</td>
<td>1</td>
<td>1.55</td>
</tr>
<tr>
<td>Control</td>
<td>7</td>
<td>0.36</td>
<td>0.18</td>
<td>0.17</td>
<td>0.69</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anchorage loss</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>8</td>
<td>0.62</td>
<td>0.44</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Control</td>
<td>16</td>
<td>1.36</td>
<td>1.07</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

The results of Mann-Whitney U Test were shown in table 3. Rate of mandibular molar protraction in experimental group was statistically significant ($p < 0.01$) greater than control group. Amount of anchorage loss in experimental group was statistically significant ($p < 0.05$) lesser than control group.

<table>
<thead>
<tr>
<th>Mann-Whitney U Test</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT vs RC</td>
<td>0.0007</td>
</tr>
<tr>
<td>AT vs AC</td>
<td>0.0301</td>
</tr>
</tbody>
</table>

RT = rate of molar protraction in experimental group  
RC = rate of molar protraction in control group  
AT = amount of anchorage in experimental group  
AC = amount of anchorage in control group

Previously, Graber[3] 1972 stated that clinicians seldom close molar space with limited orthodontic therapy because substantial anchorage needs involved and prolonged treatment time, orthodontic translation through cortical bone of atrophic ridge limited by rate of osteoclastic resorption that was about 0.5 millimeter/month [7]. Stepovich[9] 1979 stated that incomplete space closure or space reopening after treatment because adult patients resisted the formation of new bone during orthodontic space closure.

This study used the decortication-facilitated orthodontics for protraction of mandibular molar (Fig.5). This mechanic could solve the anchorage problems and also increase the rate of molar protraction because of regional acceleratory phenomenon (RAP) following selective alveolar decortications. Regional acceleratory phenomenon is a complex physiologic process with dominating features involving accelerated bone turnover and decreases in regional bone densities. Moreover, high hard and soft tissue turnover could lead to loss of tissues memory and enhanced the stability of orthodontic treatment [7].

![Lost of the left mandibular first molar. A, before treatment and B, after space closed.](image)

**Conclusions**

The present study suggests that the decortication-facilitated orthodontics treatment could protract the mandibular molar more rapidly and less anchorage loss than the conventional orthodontic treatment.
References